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(54) Fairing for aircraft control surface actuation linkage

(57) An externally mounted fairing arrangement for bridging an aircraft fixed structure 10 e.g. a wing and a control surface 11, e.g. an aileron hingedly mounted upon and angularly displaceable with respect to the fixed structure. The fairing arrangement includes a single element sealing diaphragm 23 which maintains continuity of the fairing aerodynamic shape whilst permitting differential movement between the respective parts 19, 20 of the fairing.

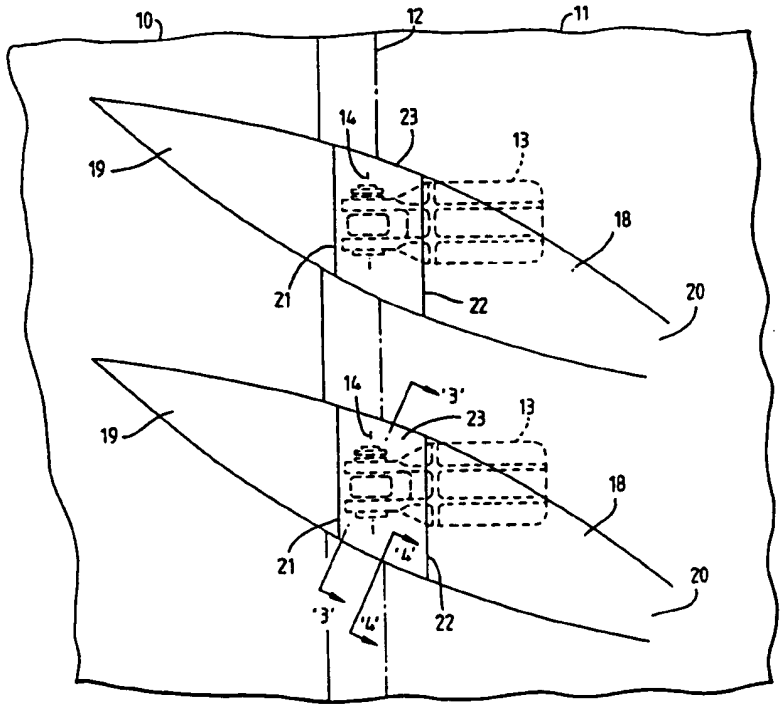

Fig. 2.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig. 1.

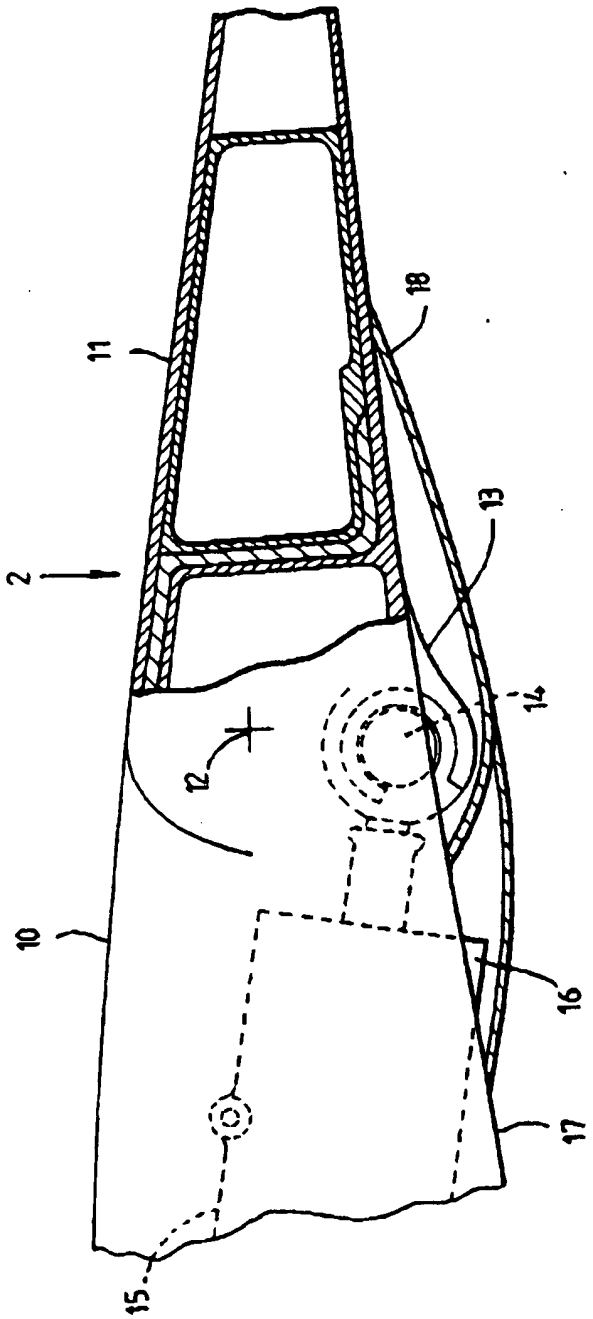
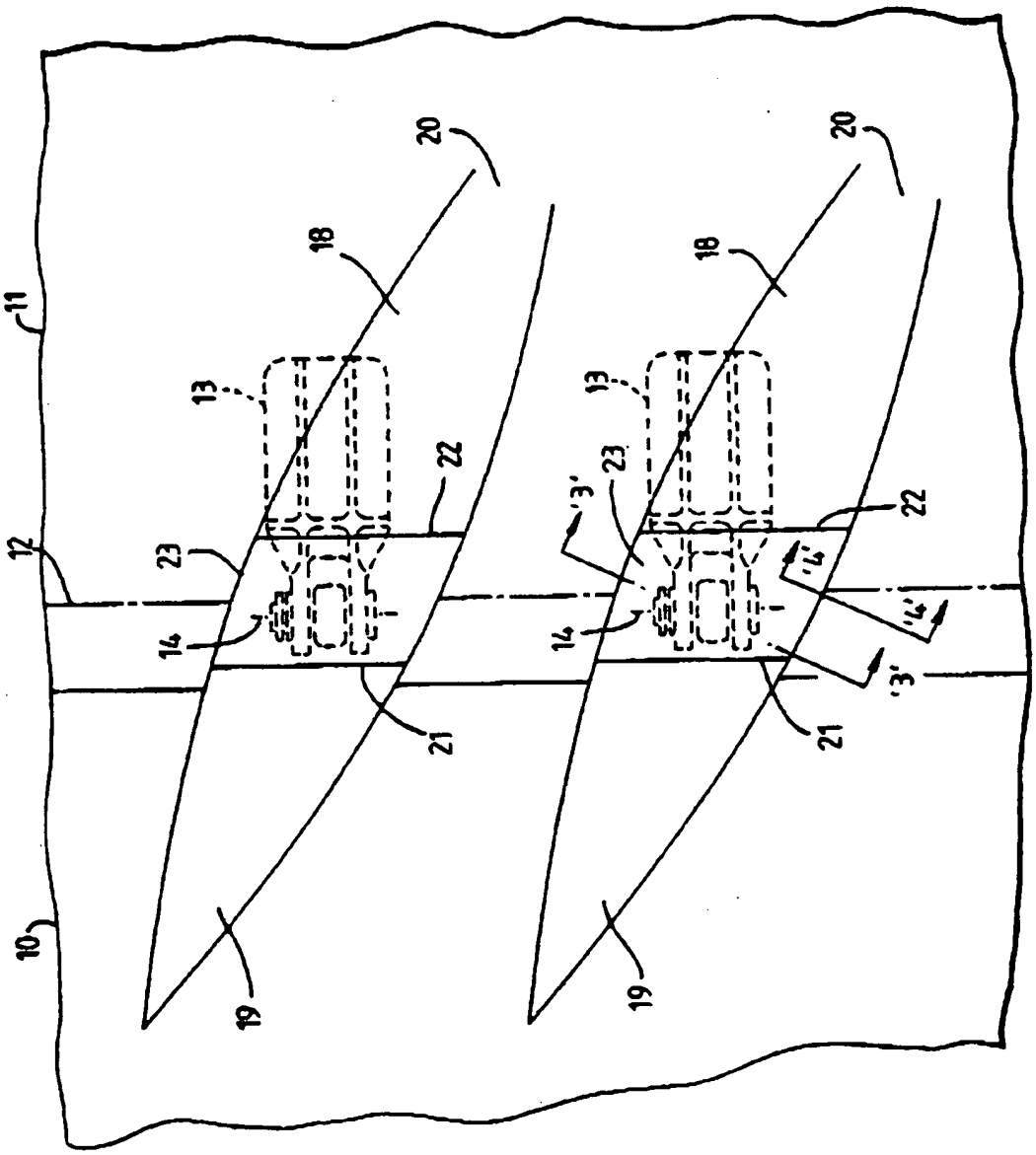


Fig. 2.



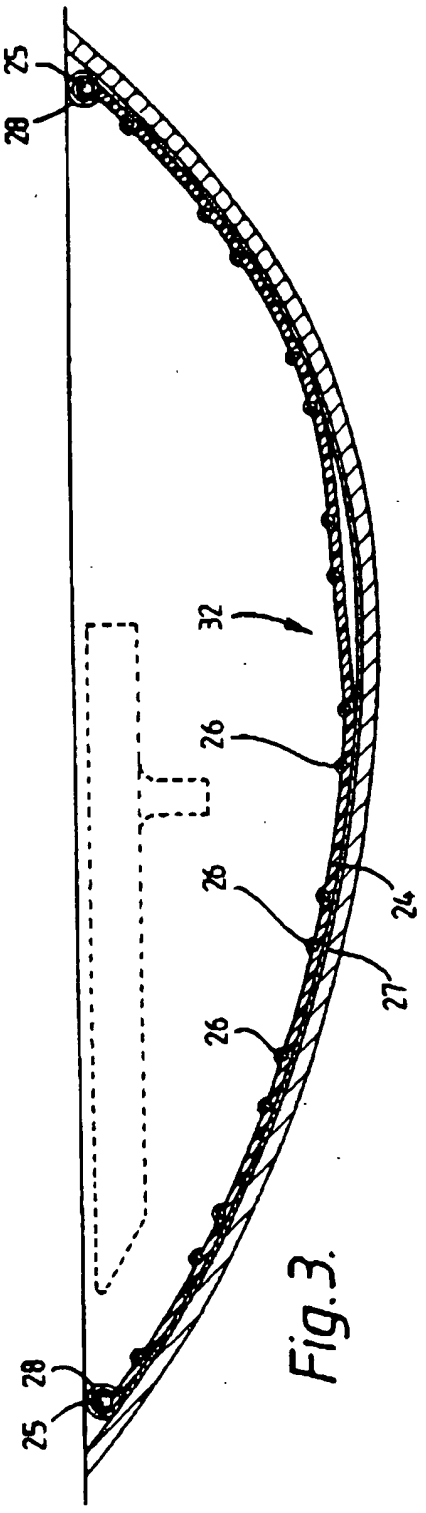


Fig.3.

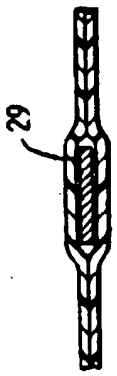


Fig.5.

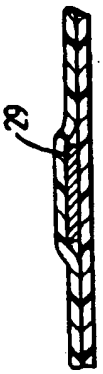


Fig.6.

Fig.7.

Fig.8.

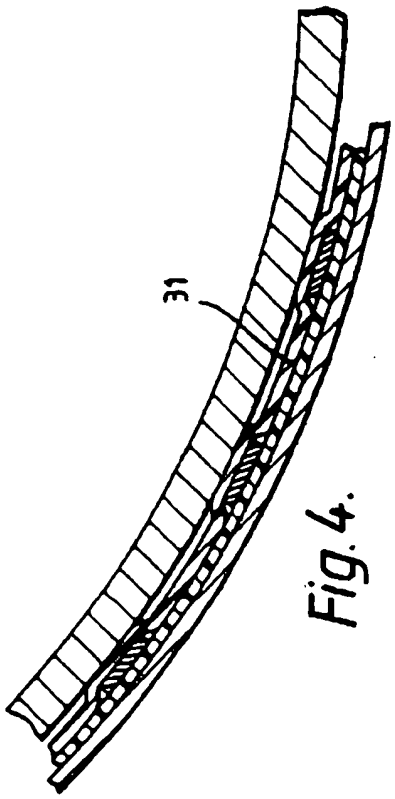


Fig.4.

FAIRING ARRANGEMENTS FOR AIRCRAFT

This invention relates to fairing arrangements for aircraft. More particularly though not exclusively it relates to seal arrangements for use with externally mounted fairings associated with flying control surfaces, for example ailerons.

In the arrangement where an aileron, for example, is hingedly attached at the trailing edge region of the wing, aileron actuating means such as an hydraulic jack, and duplicated for fail safe reasons, is pivotally located at its body end to the wing fixed structure and at its ram end to the fixed actuating lever at the aileron leading edge. For various reasons, for example the available volume within the wing structure or the need for ready accessibility, the installation may necessitate protrusion outside the wing lower profile. This in turn will necessitate an enclosing fairing which for good aerodynamic reasons of low drag will be of elongated form spanning the gap between the fixed wing trailing edge structure and the aileron. To allow for the angular deflection of the aileron however, at least that portion of the fairing bridging the said gap must be of some suitably flexible material and form but further complicated because ideally the fairing or fairings are positioned in line of flight whereas the aileron and the aileron actuating means are mounted about hinge lines which lie substantially parallel to the wing trailing edge which is swept back in

well known form. In operation, therefore, this will result in some at least slight differential lateral displacement between that part of the fairing fixedly mounted upon the wing and that mounted upon the aileron. This in turn, may lead to undesirable distortion of the flexible bridging portion. It is the object of the present invention to overcome this shortcoming by providing an improved arrangement of fairing incorporating an associated flexible seal assembly able to accommodate a wide range of angular displacement and differential movement.

Our co-pending British patent application number 8919057.3 provides an externally mounted fairing arrangement for mounting upon and bridging an aircraft fixed structure and a control surface, such as an aileron. This fairing arrangement includes a first fairing portion located upon the fixed structure, a second fairing portion located upon the control surface and an interconnecting flexible seal portion comprising a labyrinth seal made up of a number of overlapping or interlocking sealing elements able to accommodate differential movement between the first and second fairing portions when the control surface is angularly displaced relative to the fixed structure.

According to the present invention there is provided an externally mounted fairing arrangement for bridging an aircraft fixed structure and a control surface hingedly mounted upon and angularly displaceable with respect to said

aircraft fixed structure, said fairing arrangement including a first fairing portion located upon said fixed aircraft structure, a second fairing portion located upon said control surface and an intermediate flexible seal arrangement interconnecting and bridging the gap between said first and second fairing portions, said flexible seal arrangement including a single element sealing diaphragm configured to conform to the cross-sections of said first and second fairing portions but deformable to accommodate differential movement between the fairing portions when said control surface is angularly displaced relative to said aircraft fixed structure while still maintaining a substantially smooth surface continuity.

Preferably said sealing diaphragm is of non-metallic material, for example of a suitable fabric or of moulded flexible plastic but may conveniently include surface stabilising elements incorporated into the diaphragm. In the case of the fabric diaphragm these stabilising elements will be stitched in place or in the case of the moulded plastic diaphragm moulded in situ. These stabilising elements may be flexible rods, for example of circular cross-section, or they may be of flat strip. Generally speaking they will be disposed in a substantially longitudinal direction at convenient spacings consistent with surface stabilising requirements. Preferable also, at least some of these stabilising elements will be preformed

to give an element of spring loading particularly at or adjacent to the longitudinal boundaries in the case of the externally mounted seal as hereinafter described. The degree of spring loading will be determined by the induced aerodynamic suction loads which the diaphragm must satisfactorily react.

Alternative embodiments of the invention will now be described, by way of example only and with reference to the accompanying drawings in which:-

Figure 1 is a sectional side elevation through an aircraft wing/aileron interface.

Figure 2 is a view on that arrangement in direction of Arrow 2 in Figure 1.

Figure 3 is a cross-section across the flexible seal assembly viewed in direction of arrows "3-3" in Figure 2 showing an internally mounted seal.

Figure 4 is a part cross-section through an alternative flexible seal arrangement viewed in direction of arrows "4-4" in Figure 2 showing an externally mounted seal.

Figures 5-8 inclusive show alternative arrangements of flexible seal diaphragm incorporating reinforcements.

Referring to the drawings Figure 1 illustrate a trailing edge portion 10 of an aircraft wing and a portion of aileron 11 hinge mounted at 12 to the wing by a hinge mounting bracket (now shown). A lever bracket 13 mounted on the forward face of the aileron provides a pivotal

attachment 14 for an hydraulic jack 16, the jack body 15 being pivotally attached (not shown) to the wing structure. The jack 16 and the bracket 13 protrude outside the bottom wing profile 17 and are enclosed within a fairing 18 as more clearly illustrated in Figure 2.

As shown in Figure 2, the aileron 11 has duplicated actuation, ie twin lever brackets 13 and jacks 16 and consequently, in this embodiment, twin streamline fairings 18. It would be possible but less preferable for reasons of drag to utilise a single all-encompassing fairing.

The fairings 18 are disposed upon the wing in line of flight, that is chordwise with respect to the aircraft longitudinal centre line whereas the aileron actuating means lie normal to the wing structure.

Each fairing 18 includes a forward fairing 19 and a rearward fairing 20 having cut lines 21 and 22 respectively and an interconnecting flexible seal assembly 23.

The flexible seal arrangement may be of two forms. It may either be internal as in figure 3, that is it lies substantially along the inner profile of the first and second fairing portions or, alternatively it may be external, as partially illustrated in Figure 4. Both arrangements are equally effective.

Referring to Figure 3 the seal assembly 23 comprises a diaphragm 24 extending longitudinally to span the gap between the fairing portions and in width it terminates at

approximately the intersection of the fairing portion with the surface of either fixed structure or control surface to which it is attached. The seal incorporates a bead 25 and a number of longitudinal reinforcing members 26. The diaphragm seal 24 is supported on a carrier 27 which incorporates longitudinal rolled edges 28 for slidably engaging the beads 25.

In the arrangement of Figure 3 a moulded diaphragm 24 is illustrated. The diaphragm however may also be of fabric construction and include various reinforcements. For example, metallic reinforcement strips 29 may be utilised which may be sewn in as the arrangements of Figures 5 and 6 or moulded as in Figure 7. As an alternative to flat metallic strips longitudinal rods 30 may be employed and other variations may be employed depending upon requirements. Although metallic strips are indicated these may be, in fact, metallic fingers projecting from a carrier (not shown) and preformed to the desired cross-sectional shape prior to incorporating into the diaphragm.

Particularly in the case of an external diaphragm assembly 31 as shown in Figure 4, the reinforcement whether of strip or rod may require to be preformed with spring like properties with the express purpose of stiffening the diaphragm but more importantly reacting induced airloads to ensure conformity with aerodynamic profiles.

In operation, the diaphragm 24 or 31 being in slidable engagement, accommodate differential movement both longitudinal and lateral arising from flying control angular displacement. In the internal arrangement the edge restraint will result in controlled buckling of the diaphragm in the forward region of the diaphragm but not in the area bridging the two fairing portions. This buckling is partially indicated at 32 in Figure 3. To ensure smoothly sliding engagement of the diaphragm the relevant diaphragm surface may be coated in suitable low friction material eg, PTFE.

CLAIMS

1 An externally mounted fairing arrangement for bridging an aircraft fixed structure and a control surface hingedly mounted upon and angularly displaceable with respect to said aircraft fixed structure, said fairing arrangement including a first fairing portion located upon said fixed aircraft structure, a second fairing portion located upon said control surface and an intermediate flexible seal arrangement interconnecting and bridging the gap between said first and second fairing portions, said flexible seal arrangement comprising a single element sealing diaphragm configured to conform to the cross-sections of said first and second fairing portions but deformable to accommodate differential movement between the fairing portions when said control surface is angularly displaced relative to said aircraft fixed structure while still maintaining a substantially smooth surface continuity.

2 A fairing arrangement according to Claim 1 in which said sealing diaphragm is of fabric material and includes surface stabilising elements stitched in position.

3 A fairing arrangement according to Claim 1 in which said sealing diaphragm is of moulded flexible plastic and includes spaced-apart surface stabilising elements moulded in-situ.

4 A fairing arrangement according to Claim 1 or Claim 2 in which said surface stabilising elements are flexible rods, for example, of circular cross-section.

5 A fairing arrangement according to Claim 2 or Claim 3 in which said surface stabilising elements are a flat strip.

6 A fairing arrangement as substantially described with reference to the accompanying drawings.

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